Method of manufacturing a bottle-shaped metal container

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Cited documents:

US3964412
US4493201
US1948437
US2116199
EP0053240
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Abstract of **EP0740971**

Method of manufacturing a bottle-shaped metal container comprising the steps of

providing a blank of metal;
forming said blank into a body having
a mainly cylindrical portion (2);
a mainly closed end (4) at one extremity of the cylindrical portion;
an open end (3) at the other extremity of the cylindrical portion;
forming said body at its closed end (4) into a neck portion extending away from the cylindrical portion and having, in a cross section perpendicular to the axis of the cylindrical portion, smaller dimensions than the cylindrical portion which neck portion is to form the neck portion of the bottle-shape container;
closing said open end of the cylindrical portion with a bottom portion which bottom portion is to form the bottom of the bottle-shaped container.

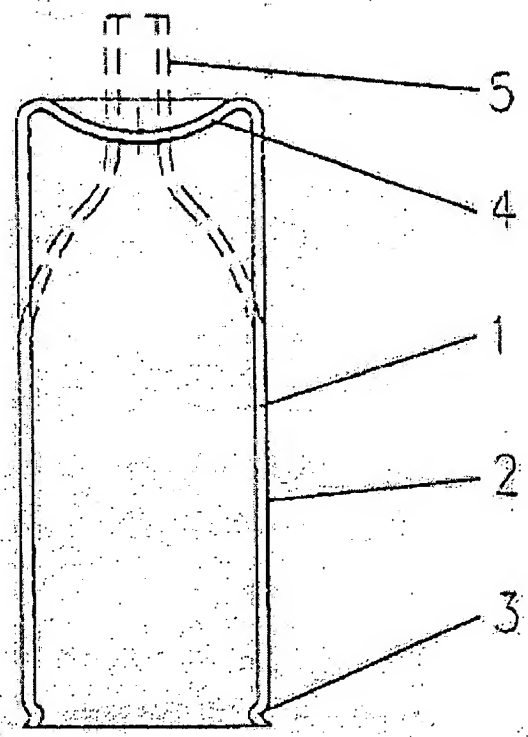

FIG. 1

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(54) Method of manufacturing a bottle-shaped metal container

(57) Method of manufacturing a bottle-shaped metal container comprising the steps of

providing a blank of metal;

forming said blank into a body having

a mainly cylindrical portion (2);

a mainly closed end (4) at one extremity of the cylindrical portion;

an open end (3) at the other extremity of the cylindrical portion;

forming said body at its closed end (4) into a neck portion extending away from the cylindrical portion and having, in a cross section perpendicular to the axis of the cylindrical portion, smaller dimensions than the cylindrical portion which neck portion is to form the neck portion of the bottle-shape container;

closing said open end of the cylindrical portion with a bottom portion which bottom portion is to form the bottom of the bottle-shaped container.

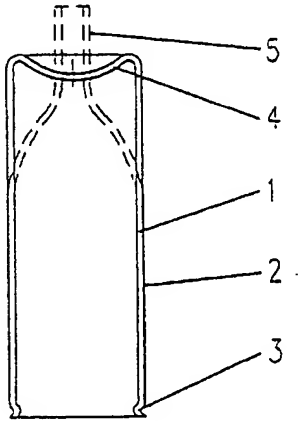

FIG. 1

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Description

The invention relates to a method of manufacturing a bottle-shaped metal container.

Today there is interest in mass-produced bottle-shaped metal containers for instance for beverages. Known metal containers for beer and beverages are in the form of steel or aluminium DWI-cans, having a substantially circle cylindrical portion with an integrated bottom and a mainly flat lid. Also known are cans with a welded body which may have a shaped form, like for instance with the beer glass shaped Saporro beer can. However, mass-produced cans having a neck portion as is characteristic for a bottle are not known.

Applicants have tried to obtain a bottle-shaped metal container having a neck portion starting from DRD (Drawn and ReDrawn) or DWI (Drawn and Wall-Ironed) can bodies by spin flow operation and the like of the cylindrical portion of such can bodies at their open end. It has however appeared that the material of such cylindrical portion can not be cold worked to the degree necessary to obtain a neck portion of a bottle shape.

One object of the invention is to provide a successful method of manufacturing a bottle-shaped metal container.

Another object of the invention is to provide a method of manufacturing of a bottle-shaped metal container which is suitable for mass-production of such containers.

The objects of the invention are obtained by a method of manufacturing a bottle-shaped metal container comprising the steps of

- providing a blank of metal;
- forming said blank into a body having
  - a mainly cylindrical portion;
  - a mainly closed end at one extremity of the cylindrical portion;
  - an open end at the other extremity of the cylindrical portion;
- forming said body at its closed end into an neck portion extending away from the cylindrical portion and having, in a cross section perpendicular to the axis of the cylindrical portion, smaller dimensions than the cylindrical portion which neck portion is to form the neck portion of the bottle-shaped container;
- closing said open end of the cylindrical portion with a bottom portion which bottom portion is to form the bottom of the bottle-shaped container.

The invention is based on the insight, that with a DRD- or DWI-can body, the bottom, in forming said can body from a blank, is essentially not cold worked, so that the ductility necessary for forming the neck portion of the bottle shaped container is still available in the metal of the bottom of a DRD- or DWI-can body. The material of the cylindrical portion of such can body has been heavily cold worked, is heavily work-hardened and can not be cold worked further to form a neck portion for a bottle-shaped container. Consequently it is proposed to make a can body from a blank and to form a neck portion at the closed end of the can body. As a matter of fact these operations can at least partly be combined into one operation. The blank may have a hole in it to form later on the opening of the neck portion of the bottle shaped metal container. The container is finished by closing the resulting part with a bottom portion using conventional methods. The container may be circle cylindrical in cross section but the invention is not restricted thereto. The container may also have a mainly square or rectangular cross section. The container may be given a specific shape by means of for instance hydraulic expansion or compression.

In a first embodiment a DWI-type route of manufacturing is applied. Thereby the body is formed by deep-drawing the blank into a cup. The closed end of the cup may be given a dome shape extending away from the cylindrical portion of the cup. This facilitates the forming later on of the neck portion. Thereafter the neck portion is formed by subjecting the cup to a DWI-operation, using tools suitable to form the neck portion, comprising a punch having a front part being at least a preform of the neck portion to be formed and a die having a contra form to that front part.

It is remarked that a DWI-operation is known to manufacture a DWI-can body with a bottom, which is dome-shaped inwardly into the can body but not to manufacture a can body with a "closed" end having a neck portion extending away from the can body. If necessary after the forming of the neck portion, the neck portion is further elaborated by a spin flow operation. Spin flow operation comprises forming processes by which the material is plastically deformed like spinning, flow turning, roller shaping and the like.

In a second embodiment of the invention a DRD-type route of manufacturing is used. Thereby the body is formed by subjecting the blank to a DRD-operation and the neck is formed by subjecting the body at its closed end to a spin flow operation.

The open end of the cylindrical portion may be closed with an easy open end.

Preferably the blank is made from steel or aluminium sheet with a thickness in the range of 0.05 - 0.50 mm.

The invention will be elucidated by means of the drawing

Fig. 1 shows an artist impression of the principle of the invention;
Fig. 2 shows an embodiment of the invention in which a DWI-operation is used;
Fig. 3 shows an embodiment of the invention using a DRD-operation.

Fig. 4 shows an embodiment using a hydraulic method for expansion of the body and shaping of the container.

In Fig. 1 with straight lines a can body 1 for instance of steel or aluminium is shown obtained by a DRD or a DWI operation, having a cylindrical body portion 2, which may be necked at its open end 3 and a closed end 4. The cylindrical portion 2 is heavily work hardened during the forming operation and can be formed further only to a very limited extent. The principle of the invention is that one does not try to obtain an elongated neck portion of the bottle shape by forming the can body 1 at its open end 3 but contrary thereto at its closed end 4 to obtain the elongated neck portion 5 as shown in dashed lines.

In the embodiment of Fig. 2 the blank 6 is formed by deep drawing into a cup 7 having a mainly cylindrical portion 8, a closed end 9 and an open end 10. The deep drawing is done in two steps A and B. The dimensions of the cylindrical portion after step A are larger than after step B. The dimensions of the cylindrical portion after step B are those of the container to be manufactured. The cup 7 has a closed end 9 which is dome shaped. The dome shape is extending away from the cylindrical portion 8. A cup having no dome-shape is indicated with a dotted line 30 in step A. The dome-shaped cup may have a flat portion 31. Cups 7 are subjected to a DWI-operation in which the cups are forced by a punch 11 to pass through a tool box 12 for the DWI process containing three of four DWI rings 13 by which the cylindrical portion 8 of the cup is extended in its length direction by wall ironing. The front part 14 of the punch 11 is shaped as a (pre)form of the more or less elongated neck portion of the bottle shaped container. The known DWI-can has a bottom which is dome-shaped inwardly into the can to withstand internal pressure. The bottom is made by the shape of the front part of the punch and by a contra form of a die at the bottom station 29. With the invention the bottom station 29 is provided with a die (not shown) having a contra form to the (pre)form of the neck portion of the front part of the die. After passing through toolbox 12 the body 15 having a neck portion 16 is ejected. Thereafter the neck portion 16 of the body 15 may be further elaborated by a spin flow operation as indicated at 17. Thereafter the flange portion 18 of the body is trimmed at 20.
Finally the open end 19 of the body is closed with a bottom portion and eventually the container is given a specific shaped form by hydraulic expansion or compression.

The filling, closing and opening of the bottle-shaped metal container can be done in two different ways. The first way is that the container is filled at its neck portion and is closed with a crown cork or screw cap. The second way is that the container is filled at its bottom portion and is closed with an easy-open end. Thus the bottle-shaped metal container can either be opened at its neck portion or at its bottom portion.

In the embodiment of Fig. 3 firstly a can body 21 is produced using a DRD-process. Subsequently the can body 21 is subjected to a spin flow operation at its closed end 22 to form a neck portion 23, and the flange portion 24 at the open end 25 of the can body is trimmed. Thereafter the open end 25 of the body 26 provided with the neck portion 23 is closed with a bottom portion 27, which bottom portion as shown in Fig. 3 may have itself a can form.

Finally the container thus obtained may be given a specific shaped form by hydraulic expansion or compression as shown schematically with arrows 28.

Printing of the container can be done in two different ways. The first way is that the container is printed before shaping. The whole container may first be given a white base coat; thereafter the cylindrical portion may be decorated. The second way is that the container is decorated by means of a shrinksleeve after shaping.

Fig. 4 shows by way of example an embodiment in which the bottle-shaped container should be given a special shape, different from the cylindrical shape, for instance the shape of a cola bottle. For this purpose the body is initially brought in the form as shown in Fig. 4, right side, as with the DWI-operation of Fig. 2. The body 1 has a cylindrical portion 2, a neck portoin 5 and an open end 3. In the DWI-operation the cylindrical portion 2 is heavily work hardened and has retained only a small elongation at rupture. Under these conditions the body can still be deformed i.e. expanded without rupture of the wall of the cylindrical portion 2 to a very limited extent. A bottle-shaped container made from tinplate has after the DWI-operation an elongation at rupture of less than 1 %, and would crack at an expansion of its diameter of less than 1 %.

Surprisingly it has appeared that the heavily work hardened cylindrical portion 2 can still be expanded if the special measures which are described in the following are applied.

The DWI-body is expanded by a special hydraulic expansion, whereby a high pressure is exerted on the inside of the body as well as on the outside thereof. For this purpose the body 1 is introduced in a hollow die 40, consisting of two shaped halves 40a, 40b. The internal shape 41 of the hollow die forms a cavity which is mainly in conformity with the external shape of the furnished container 8, as shown in Fig. 4, left side. A rubber bag 22 filled with a fluid, for instance water, one end whereof is clamped between the holding parts 33 and 34 is at the open end 3 introduced into the formed body 1. The outer space 36 formed between the outer wall 1a of the body 1 and the internal shape 41 of the cavity 40 is at the upper side pressure tight closed by means of the holding part 33 and the seal 35. The outer space 36 is filled completely with fluid, for instance water. Air can escape through a valve (not shown). There is exerted a force F1 on a piston 37, which is movable in holding part 34, by which force the piston 37 is pressed into the rubber bag 32. The bag nestles itself against the inner wall 1i of the body 1. Air between the rubber bag 32 and the

inner wall 1i can escape. By means of the piston 37 or other suitable means, for instance a pump, the inner space 38 of the rubber bag 32 and thereby also the inner space of the body 1 is pressurized with a pressure pi. At the same time the outer space 35 is pressurized by means of a piston 39, on which a force F2 is exerced, or by other suitable means, with a pressure pa, which is smaller than the pressure pi. The material of the wall of the body 1 is brought to yield by the pressure difference between p1 and p2.

Surprisingly it has appeared that the heavily cold worked material of the cylindrical portion 2 can be expanded in diameter for 10 % and more, when very high pressures are exerted inside and outside the body 1. If the body is for instance of tinplate, then with an increase of the diameter D1 of the formed body 1 to a diameter D2 of the finished container of 20 %, the external pressure pa should be about 1000 bar. This means that the pressure pi in the inner space 38 must be higher for the expansion of the body. The internal pressure should be about 1200 bar. With the pressure from all sides the heavily work hardened material does not crack during the expansion. For the expansion of the body a pressure difference pi-pa of about 200 bar is required. With a smaller expansion of the diameter of for instance 10 % the external pressure pa can be portionally lower and should be about 500 bar. Use of external pressures up to 10000 bar is required in dependency of the material and work hardening previously given.

Claims

1. Method of manufacturing a bottle-shaped metal container comprising the steps of

   - providing a blank of metal;
   - forming said blank into a body having

     . a mainly cylindrical portion;
     . a mainly closed end at one extremity of the cylindrical portion;
     . an open end at the other extremity of the cylindrical portion;

   - forming said body at its closed end into a neck portion extending away from the cylindrical portion and having, in a cross section perpendicular to the axis of the cylindrical portion, smaller dimensions than the cylindrical portion which neck portion is to form the neck portion of the bottle-shaped container;
   - closing said open end of the cylindrical portion with a bottom portion which bottom portion is to form the bottom of the bottle-shaped container.

2. Method in accordance with claim 1 whereby the body is formed by deep drawing the blank into a cup.

3. Method in accordance with claim 2 whereby the closed end of the cup is given a dome shape extending away from the cylindrical portion of the cup.

4. Method in accordance with claim 1-3 whereby the neck portion is formed by subjecting the cup to a DWI-operation, using tools suitable to form the neck portion.

5. Method in accordance with claim 4 whereby the tools comprise a punch used in the DWI-operation having a front part being at least a preform of the neck portion to be formed and a die having a contra form to that front part.

6. Method in accordance with claim 1-5, whereby after the forming of the neck portion, the neck portion is further elaborated by a spin flow operation.

7. Method in accordance with claim 1 whereby the body is formed by subjecting the blank to a DRD-operation.

8. Method in accordance with claim 7 whereby the neck is formed by subjecting the body at its closed end to a spin flow operation.

9. Method in accordance with claim 1-8 whereby the open end of the cylindrical portion is closed with an easy open end.

10. Method in accordance with claim 1-9 whereby after closing the open end of the cylindrical portion with the bottom portion the container is formed by hydraulic expansion or hydraulic compression to finally obtain a specific shaped form.

11. Method in accordance with claims 1-10, whereby the blank is made from steel or aluminium sheet with a thickness in the range of 0.05 - 0.50 mm.

12. Method in accordance with claims 1-8, 11 characterized in that the body (1), having after the DRD or the DWI operation a cylindrical portion (2) with an open end (3) and a neck portion (5), is expanded by hydraulic expansion in a cavity, of which the internal shape is mainly in conformity with the external shape of the container (8), whereby the body is subjected to an internal hydraulic pressure pi and an external hydraulic pressure pa, the internal pressure pi is higher than the external pressure pa and the external pressure is at least 500 bar.

13. Method in accordance with claim 12, characterized in that the external pressure pa at an expansion of the diameter D1 of the cylindrical portion (2) of 20 % is about 1000 bar.

14. Method in accordance with claim 12 or 13, characterized in that, for generating the internal hydraulic pressure pi in the body, a rubber bag filled with a fluid is introduced into the body at the open end thereof and that the fluid in the rubber bag is pressurized.

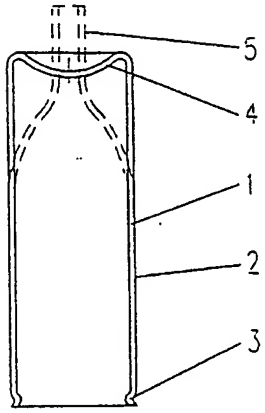
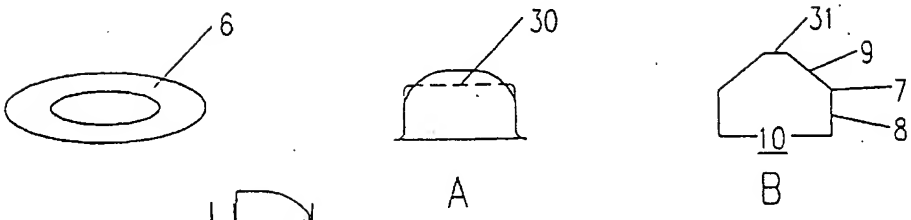


FIG. 1



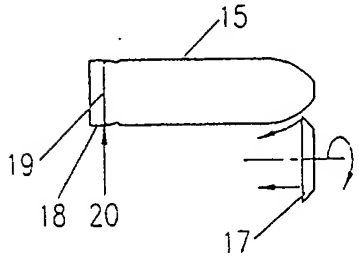


FIG. 2

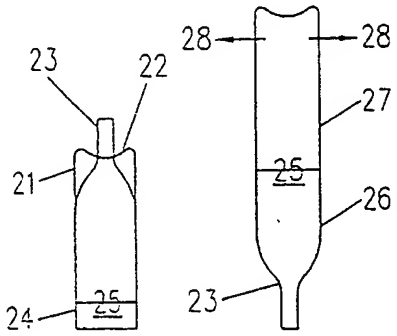
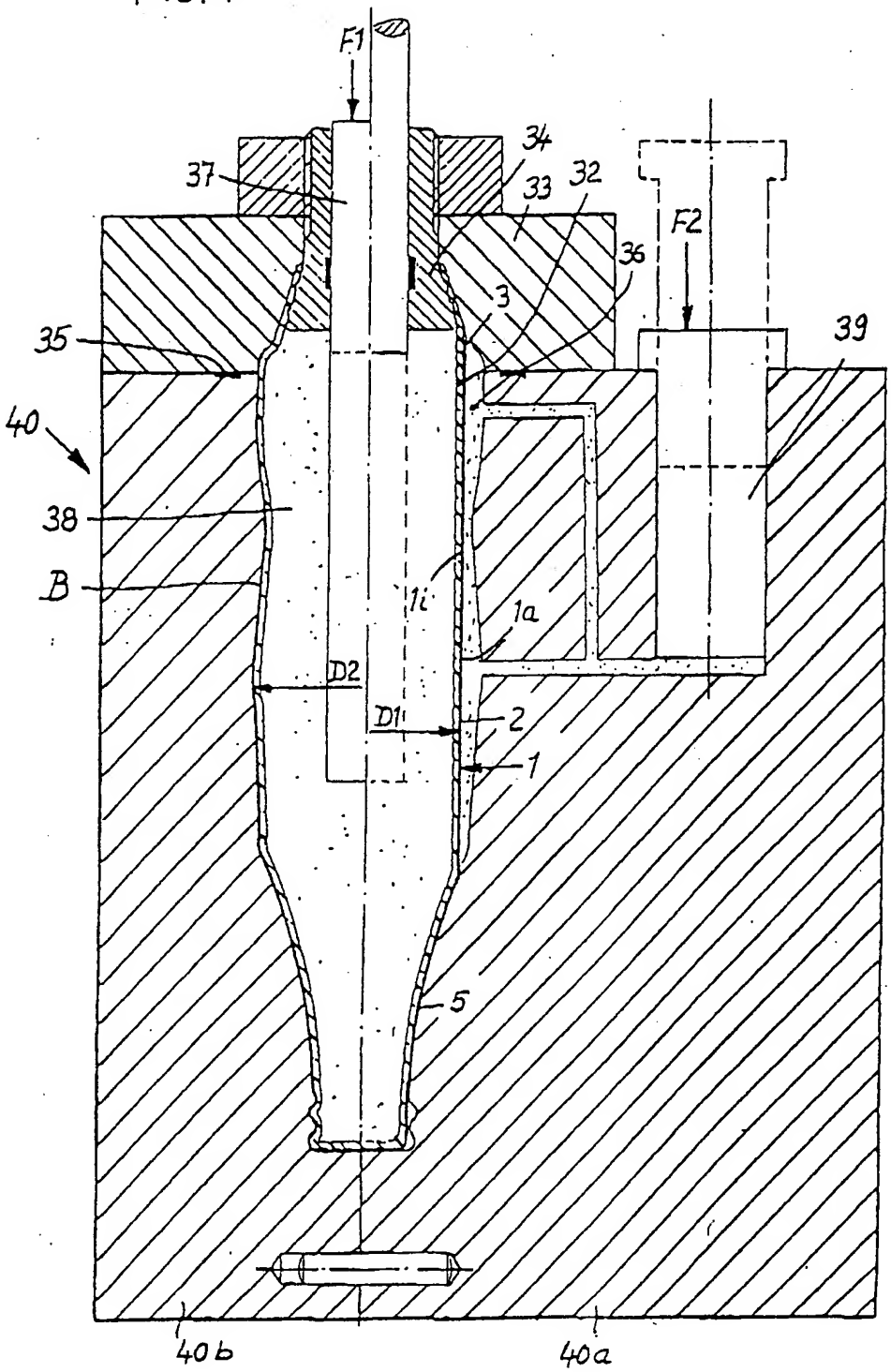


FIG. 3

FIG. 4



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EUROPEAN SEARCH REPORT

Application Number
EP 95 20 1153

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	PATENT ABSTRACTS OF JAPAN vol. 950 no. 003 & JP-A-07 060386 (TOYO RIKAGAKU KENKYUSHO:KK) 7 March 1995, * abstract *	1-5,7	B21D51/00 B21D51/24
A	US-A-3 964 412 (KANAME KITSUDA) * the whole document *	1	
A	US-A-4 493 201 (SCHMIDT)		
A	US-A-1 948 437 (BOWERS)		
A	US-A-2 116 199 (HELD)		
A	EP-A-0 053 240 (TUBETTIFICIO LIGURE)		
A	US-A-4 541 546 (KATSUHIRO IMAZU)		

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

B21D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	6 October 1995	Peeters, L

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